



Appl. No.: 10/620,557

#### Appendix A

Attached as Appendix B are verified English translations of the instant priority documents Japanese Patent Application No. 2003-153159 filed on May 29, 2003 and Japanese Patent Application No. 2002-377006 filed on December 26, 2002.

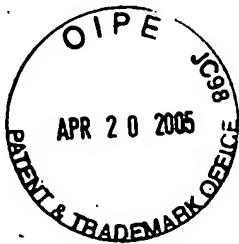
This IDS cites US Patent Application Publication 2004/0238793 A1 ('793 Publication) for the Examiner's consideration. The Examiner will note that the '793 Publication is based on Application No. 10/250,023 which has a filing date of May 29, 2003. Accordingly, **both** Application No. 10/250,023 and the instant priority document Japanese Patent Application No. 2003-153159 have a filing date on the same day, i.e., **May 29, 2003**.

It is submitted that the claims of the present application are patentable over the '793 publication because:

(1) the '793 publication does not teach the morphology of the carbon black present in the masterbatch as recited in the claims of the present application; and

(2) all of the claims of the present application are supported by Japanese Patent Application No. 2003-153159 filed on May 29, 2003; **therefore the '793 publication is not prior art.**

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APPENDIX B, Part 1

DECLARATION OF TRANSLATOR

I, Maho KASEKI, c/o the Inoue & Associates of 3rd Floor, Akasaka Habitation Building, 3-5, Akasaka 1-chome, Minato-ku, Tokyo, Japan do solemnly and sincerely declare that I am well acquainted with the Japanese and English languages and that I have executed with the best of my ability this translation into English of the Certified Copy of Japanese Patent Application No. 2002-377006 and believe that the translation is true and correct.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

April 19, 2005  
(Date)

Maho Kaseki  
Maho KASEKI



JAPAN PATENT OFFICE

This is to certify that the annexed is a true copy of the  
following application as filed with this Office

Date of Application : December 26, 2002  
Application Number : Patent Application No. 2002-377006  
[ST.10/C]: [JP2002-377006]  
Applicant(s) : Asahi Kasei Kabushiki Kaisha

July 18, 2003

Yasuo IMAI  
Commissioner,  
Japan Patent Office  
Certif. No. 2003-3057318



2002-377006

[Name of Document] Patent Application

[Reference Number] X1021202

[Submitted to] Commissioner, Japan Patent Office

[International Patent Classification] C08L 71/00

C08L 77/00

H01L 1/20

[Title of the Invention] Conductive Masterbatch and Conductive  
Resin Composition

[Number of Claims] 10

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[Advance Payment Ledger Number] 013491

[Amount of Advance Payment] ¥21,000

[List of Materials Being Submitted]

[Name of Material]	Specification	1
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[Name of Material]	Abstract	1
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[General Power of Attorney Number] 0102570

[Necessity or Non-Necessity of Proof] Necessary

[Name of Document] Specification

[Title of the Invention] Conductive masterbatch and conductive resin composition

[Scope of Claims for Patent]

[Claim 1] A conductive masterbatch comprising a polyamide and a conductive filler, wherein a part of said conductive filler is present in the form of at least one agglomerated particle.

[Claim 2] The conductive masterbatch according to claim 1, wherein a part of said conductive filler is present in the form of at least one agglomerated particle having a major axis of 20  $\mu\text{m}$  or more.

[Claim 3] The conductive masterbatch according to claim 1 or 2, wherein a part of said conductive filler is present in the form of at least one agglomerated particle having a major axis of 30  $\mu\text{m}$  or more.

[Claim 4] The conductive masterbatch according to any one of claims 1 to 3, wherein a part of said conductive filler is present in the form of at least one agglomerated particle having a major axis of 30  $\mu\text{m}$  or more, wherein the number of said at least one agglomerated particle is 1 to 50 as observed under an optical microscope with respect to a contiguous area of 3  $\text{mm}^2$ .

[Claim 5] The conductive masterbatch according to any one of claims 1 to 4, wherein said conductive filler is at least one member selected from the group consisting of a conductive carbon black, a carbon nanotube, a carbon nanofiber, a carbon fiber and graphite.

[Claim 6] The conductive masterbatch according to any one of claims 1 to 5, wherein said conductive filler is a conductive carbon black having a DBP oil absorption of at least 250 ml per 100 g of the carbon black.

[Claim 7] A conductive resin composition comprising a polyamide, a polyphenylene ether and a conductive filler, which is produced using the conductive masterbatch of any one of claims 1 to 6..

[Claim 8] The conductive resin composition according to claim 7, wherein the amount of the conductive filler is in the range of from 0.2 to 5 parts by weight, relative to 100 parts by weight of the total of the components of the conductive resin composition excluding the conductive filler.

[Claim 9] An injection molded article comprising the conductive resin composition of claim 7 or 8.

[Claim 10] A molded article for use as an exterior part of an automobile, which comprises the conductive resin composition of claim 7 or 8.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a masterbatch used for providing a resin composition which has a conductivity sufficient for the resin composition to be electrostatically coated, and also relates to a resin composition and a molded article which are produced using the above-mentioned masterbatch.

The resin composition of the present invention can be used in a wide variety of fields, such as electric and electronic parts, parts of office automation machines, automobile parts and other mechanical parts. Especially, the resin composition can be used advantageously for producing an exterior part for an automobile which can be electrostatically coated.

[0002]

[Prior Art]

Polyphenylene ethers not only have excellent mechanical and electrical properties and excellent heat resistance, but also have excellent dimensional stability. Therefore, polyphenylene ethers have been used in a wide variety of fields. However, the moldability of a polyphenylene ether is poor. For improving the moldability of a polyphenylene ether, a



technique in which a polyamide is added to a polyphenylene ether, to thereby obtain a polyamide-polyphenylene ether alloy, is proposed (patent document 1). Nowadays, polyamide-polyphenylene ether alloys are used in a very wide variety of fields.

[0003]

Recently, use of a conductivity-imparted polyamide-polyphenylene ether alloy is rapidly expanding in the fields of electrostatically coatable automobile outer panels (such as a fender and a door panel). The materials used for an automobile outer panel are required to have various good properties, such as a conductivity sufficient for electrostatic coating, impact resistance, heat resistance and melt-fluidity.

[0004]

With respect to the method for imparting a conductivity to a polyamide-polyphenylene ether alloy, for example, there is disclosed a technique to lower the surface resistance of a polyamide-polyphenylene ether alloy by a method in which carbon black is caused to be contained mainly in the polyamide phase of the polyamide-polyphenylene ether alloy, or by a method in which carbon black is uniformly dispersed in a polyamide, followed by mixing thereof with a polyphenylene

ether (patent document 2).

[0005]

Further, a composition which contains a conductive carbon fibril and has excellent impact resistance and volume resistivity is disclosed (documents 3 and 4).

[0006]

However, the resin compositions obtained by the above-mentioned conventional techniques do not have a satisfactory conductivity and, hence, is not suitable for use in the above-mentioned application fields. Therefore, the development of a new technique has been desired in the art.

[0007]

[Patent document 1]

Examined Japanese Patent Publication No. Sho 45-997  
(page 1, claims)

[Patent document 2]

Unexamined Japanese Patent Application Laid-open  
Specification No. Hei 2-201811  
(page 1, claims 1 and 2)

[Patent document 3]

Patent Application prior-to-examination Publication

(Kohyo) Hei 8-508534

(page 2, claim 1)

[Patent document 4]

U.S. Patent No. 5,643,502

(column 18, claim 1)

[0008]

[Problems to Be Solved by the Invention]

It is an object of the present invention to impart a polyamide/polyphenylene ether alloy with a conductivity sufficient for the alloy to be electrostatically coated.

[0009]

[Means to Solve the Problem]

The present inventors have made extensive and intensive studies with a view toward solving the above-mentioned problems. As a result, it has surprisingly been found that, when a resin composition is produced using a masterbatch in which a conductive filler is present in the form of at least one agglomerated particle, the produced resin composition exhibits a conductivity sufficient for the resin composition to be electrostatically coated. The present invention has been completed, based on this finding.

[0010]

Accordingly, the present invention relates to a masterbatch used for providing a resin composition which has a conductivity sufficient for the resin composition to be electrostatically coated, and also relates to a resin composition produced using the above-mentioned masterbatch. Further, the present invention also relates to an injection molded article and a molded article for use as an exterior part of an automobile, each comprising the resin composition.

The specific constitution of the present invention is as follows.

[0011]

(1) A conductive masterbatch comprising a polyamide and a conductive filler, wherein a part of the conductive filler is present in the form of at least one agglomerated particle.

(2) The conductive masterbatch according to item (1) above, wherein a part of the conductive filler is present in the form of at least one agglomerated particle having a major axis of 20  $\mu\text{m}$  or more.

(3) The conductive masterbatch according to item (1) or (2) above, wherein a part of the conductive filler is present in the form of at least one agglomerated particle having a major axis of 30  $\mu\text{m}$  or more.

[0012]

(4) The conductive masterbatch according to any one of items (1) to (3) above, wherein a part of the conductive filler is present in the form of at least one agglomerated particle having a major axis of 30  $\mu\text{m}$  or more, wherein the number of at least one agglomerated particle is 1 to 50 as observed under an optical microscope with respect to a contiguous area of 3  $\text{mm}^2$ .

(5) The conductive masterbatch according to any one of items (1) to (4) above, wherein the conductive filler is at least one member selected from the group consisting of a conductive carbon black, a carbon nanotube, a carbon nanofiber, a carbon fiber and graphite.

(6) The conductive masterbatch according to any one of items (1) to (5) above, wherein the conductive filler is a conductive carbon black having a DBP oil absorption of at least 250 ml per 100 g of the carbon black.

[0013]

(7) A conductive resin composition comprising a polyamide, a polyphenylene ether and a conductive filler, which is produced using the conductive masterbatch of any one of items (1) to (6) above.

(8) The conductive resin composition according to item

(7) above, wherein the amount of the conductive filler is in the range of from 0.2 to 5 parts by weight, relative to 100 parts by weight of the total of the components of the conductive resin composition excluding the conductive filler.

(9) An injection molded article comprising the conductive resin composition of item (7) or (8) above.

(10) A molded article for use as an exterior part of an automobile, which comprises the conductive resin composition of item (7) or (8) above.

[0014]

[Mode for Carrying Out the Invention]

Hereinbelow, the components of the conductive resin composition of the present invention will be described in detail.

With respect to the type of the polyamide which can be used in the present invention, there is no particular limitation so long as it is a polymer having amide  $\{-\text{NH}-\text{C}(=\text{O})-\}$  linkages in a main chain thereof.

In general, a polyamide is obtained by a ring opening polymerization of a lactam, a condensation polymerization of a diamine and a dicarboxylic acid, a condensation polymerization of an aminocarboxylic acid, and the like. However, in the present invention, the method for obtaining a polyamide is not limited to these examples.

[0015]

Examples of diamines mentioned above include aliphatic diamines, alicyclic diamines and aromatic diamines. Specifically, there can be mentioned tetramethylene diamine, hexamethylene diamine, undecamethylene diamine, dodecamethylene diamine, tridecamethylene diamine, 2,2,4-trimethylhexamethylene diamine, 2,4,4-trimethylhexamethylene diamine, 5-methylnonamethylene diamine, 1,3-bisaminomethyl cyclohexane, 1,4-bisaminomethyl cyclohexane, m-phenylene diamine, p-phenylene diamine, m-xylylene diamine and p-xylylene diamine.

[0016]

Examples of dicarboxylic acids include aliphatic dicarboxylic acids, alicyclic dicarboxylic acids and aromatic dicarboxylic acids. Specifically, there can be mentioned adipic acid, suberic acid, azelaic acid, sebacic acid, dodecanoic diacid, 1,1,3-tridecanoic diacid, 1,3-cyclohexane dicarboxylic acid, terephthalic acid, isophthalic acid, naphthalene dicarboxylic acid and a dimmer acid.

Specific examples of lactams include  $\epsilon$ -caprolactam,  $\epsilon$ -anthlactam and  $\omega$ -laurocaprolactam.

[0017]

Further, specific examples of aminocarboxylic acids in-

clude  $\epsilon$ -aminocaproic acid, 7-aminoheptanoic acid, 8-aminooctanoic acid, 9-aminononanoic acid, 11-amino-undecanoic acid, 12-aminododecanoic acid and 13-amino-tridecanoic acid.

[0018]

In the present invention, the polyamide may either be a homopolymer obtained by homopolymerizing any one of the above-mentioned compounds (i.e., lactams, diamines, dicarboxylic acids and  $\omega$ -aminocarboxylic acids), or a copolymer obtained by subjecting a mixture of at least two types of the above-mentioned compounds to a condensation polymerization.

In the present invention, it is also preferred to use a polyamide obtained by a method in which at least one of the above-mentioned compounds (i.e., lactams, diamines, dicarboxylic acids and  $\omega$ -aminocarboxylic acids) is polymerized in a polymerization reactor to thereby obtain a low molecular weight oligomer, and the obtained oligomer is subjected to further polymerization in an extruder or the like, to thereby obtain a high molecular weight polymer.

[0019]

Examples of polyamides which can be advantageously used in the present invention include polyamide 6, polyamide 6,6, polyamide 4,6, polyamide 11, polyamide 12, polyamide 6,10,



polyamide 6,12, polyamide 6/6,6, polyamide 6/6,12, polyamide 6/MXD (m-xylylene diamine), polyamide 6,T, polyamide 6,I, polyamide 6/6,T, polyamide 6/6,I, polyamide 6,6/6,T, polyamide 6,6/6,I, polyamide 6/6,T/6,I, polyamide 6,6/6,T/6,I, polyamide 6/12/6,T, polyamide 6,6/12/6,T, polyamide 6/12/6,I and polyamide 6,6/12/6,I. Further, it is also possible to use a polyamide which is obtained by copolymerizing a plurality of different polyamides using an extruder or the like.

[0020]

Preferred examples of polyamides include polyamide 6, polyamide 6,6, a polyamide 6/6,6, and a mixture thereof.

The number average molecular weight of the polyamide used in the present invention is preferably 5,000 to 100,000, more preferably 10,000 to 30,000.

[0021]

The polyamide used in the present invention is not limited to those which are exemplified above, and may be a mixture of a plurality of polyamides having different molecular weights. For example, the polyamide may be a mixture of a low molecular weight polyamide having a number average molecular weight of less than 10,000 and a high molecular weight polyamide having a number average molecular weight of 30,000 or more or a mixture of a low molecular weight polyam-

ide having a number average molecular weight of less than 10,000 and a medium molecular weight polyamide having a number average molecular weight of about 15,000.

[0022]

The terminal groups of the polyamide participate in a reaction with a polyphenylene ether. A polyamide generally has an amino group and a carboxyl group as terminal groups thereof. In general, when the carboxyl group concentration of a polyamide resin is increased, the impact resistance of such a polyamide becomes lowered whereas the melt-fluidity of the polyamide becomes improved. On the other hand, when the amino group concentration of a polyamide resin is increased, the impact resistance of such a polyamide becomes improved whereas the melt-fluidity of the polyamide becomes lowered.

[0023]

In the present invention, the concentration ratio of the amino group to the carboxyl group (amino group/carboxyl group ratio) is preferably 9/1 to 1/9, more preferably 8/2 to 1/9, still more preferably 6/4 to 1/9.

The concentration of the terminal amino group of the polyamide is preferably at least 10 milliequivalents, more preferably at least 30 milliequivalents, per kg of the polyamide.

[0024]

Any conventional methods can be used to control the amounts of the terminal groups of the polyamides. For example, there can be mentioned a method in which a diamine, dicarboxylic acid or monocarboxylic acid is added to the reaction system of a polymerization for producing a polyamide so as to obtain a polyamide having terminal groups in desired concentrations.

[0025]

Further, for improving the heat stability of a polyamide, a metal compound stabilizer as described in Unexamined Japanese Patent Application Laid-Open Specification No. Hei 1-163262 may be used.

[0026]

Among the conventional metal compound stabilizers, especially preferred are CuI, CuCl<sub>2</sub>, copper acetate and cerium stearate. It is also preferred to use halogen salts of alkali metals, such as potassium iodide and potassium bromide. These metal compounds can be used individually or in combination.

It is preferred that the metal compound stabilizer and/or the halogen salt of alkali metal is added to the polyamide in an amount of 0.001 to 1 part by weight, relative to

100 parts by weight of the polyamide.

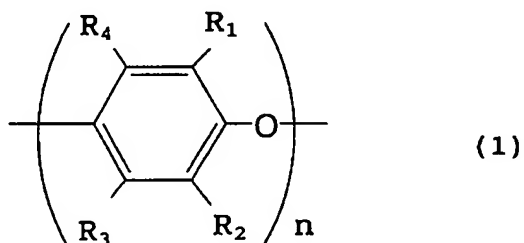
Further, any of other conventional additives for a polyamide can be also added to the polyamide. Such additive(s) can be used in an amount of less than 10 parts by weight, relative to 100 parts by weight of the polyamide.

[0027]

Examples of polyphenylene ethers which can be used in the present invention include a homopolymer and a copolymer, each independently comprising a structural unit represented by the following formula (1):

[0028]

[Chemical formula 1]



[0029]

wherein O represents an oxygen atom, and each R independently represents a hydrogen atom, a halogen atom, a primary or secondary lower alkyl group, a phenyl group, a haloalkyl group, an aminoalkyl

group, a hydrocarbyloxy group or a halohydrocarbyloxy group (in which at least two carbon atoms are present between the halogen atom and the oxygen atom).

[0030]

Specific examples of polyphenylene ethers used in the present invention include poly(2,6-dimethyl-1,4-phenylene ether), poly(2-methyl-6-ethyl-1,4-phenylene ether), poly(2-methyl-6-phenyl-1,4-phenylene ether) and poly(2,6-dichloro-1,4-phenylene ether). Further examples of polyphenylene ethers include a copolymer of 2,6-dimethylphenol and another phenol (for example, a copolymer of 2,6-dimethylphenol and 2,3,6-trimethylphenol, and a copolymer of 2,6-dimethylphenol and 2-methyl-6-butylphenol, which are described in Examined Japanese Patent Application Publication No. Sho 52-17880).

[0031]

Among the above-mentioned polyphenylene ethers, preferred are poly(2,6-dimethyl-1,4-phenylene ether), a copolymer of 2,6-dimethylphenol and 2,3,6-trimethylphenol, and a mixture thereof.

[0032]

With respect to the methods for producing the poly-

phenylene ether used in the present invention, there is no particular limitation, and any conventional methods can be used. For example, there can be mentioned methods as described in U.S. Patent Nos. 3,306,874, 3,306,875, 3,257,357 and 3,257,358 and Unexamined Japanese Patent Application Laid-Open Specification Nos. Sho 50-51197 and Sho 63-152628.

[0033]

With respect to the polyphenylene ether which can be used in the present invention, the reduced viscosity ( $\eta_{sp}/c$ ) thereof is preferably in the range of from 0.15 to 0.70 dl/g, more preferably from 0.20 to 0.60 dl/g, most preferably from 0.40 to 0.55 dl/g, as measured at 30 °C with respect to a 0.5 g/dl chloroform solution of the polyphenylene ether).

[0034]

In the present invention, a mixture of two or more different types of polyphenylene ethers having different reduced viscosities can be used without causing any problems. As examples of such a mixture, there can be mentioned a mixture of a polyphenylene ether having a reduced viscosity of 0.45 dl/g or less and a polyphenylene ether having a reduced viscosity of 0.50 dl/g or more, and a mixture of a low molecular weight polyphenylene ether having a reduced viscosity of 0.40 dl/g or less and a polyphenylene ether having a reduced viscosity

of 0.50 dl/g or more, but the polyphenylene ether mixtures are not limited to those which are exemplified above.

[0035]

The polyphenylene ether used in the present invention may contain less than 5 % by weight of an organic solvent, relative to 100 parts by weight of the polyphenylene ether, wherein the organic solvent is the residual polymerization solvent used for producing the polyphenylene ether. It is difficult to remove the residual polymerization solvent completely by the drying operation performed after the polymerization reaction, so that the solvent usually remains in the polyphenylene ether in a concentration of several hundred ppm to several % by weight. The organic solvent mentioned herein, which is the residual polymerization solvent, may be at least one solvent selected from the group consisting of toluene, isomers of xylene, ethylbenzene, alcohols having 1 to 5 carbon atoms, chloroform, dichloromethane, chlorobenzene and dichlorobenzene.

[0036]

Further, the polyphenylene ether used in the present invention may be in a modified form or may be in the form of a mixture of an unmodified polyphenylene ether and a modified polyphenylene ether.

In the present invention, the "modified polyphenylene ether" means a polyphenylene ether which is modified with at least one modifier compound having at least one unsaturated bond selected from the group consisting of a carbon-carbon double bond and a carbon-carbon triple bond and having at least one group selected from the group consisting of a carboxylic acid group, an acid anhydride group, an amino group, a hydroxyl group and a glycidyl group.

[0037]

As examples of methods for producing the modified polyphenylene ether, there can be mentioned (1) a method in which polyphenylene ether is reacted with a modifier compound in either the presence or absence of a radical initiator at a reaction temperature which is 100 °C or higher and lower than the glass transition temperature of the polyphenylene ether, so that the reaction proceeds without causing the melting of the polyphenylene ether; (2) a method in which a polyphenylene ether and a modifier compound are melt-kneaded in either the presence or absence of a radical initiator at a temperature which is equal to or higher than the glass transition temperature of the polyphenylene ether and not higher than 360 °C, to thereby perform a reaction; and (3) a method in which a polyphenylene ether and a modifier compound are



reacted in a solvent therefor in either the presence or absence of a radical initiator at a temperature which is lower than the glass transition temperature of the polyphenylene ether. In the present invention, any of the above-mentioned methods (1) to (3) can be employed, but methods (1) and (2) are preferred.

[0038]

Next, a specific explanation is made on the above-mentioned modifier compound having at least one unsaturated bond selected from the group consisting of a carbon-carbon double bond and a carbon-carbon triple bond and having at least one group selected from the group consisting of a carboxylic acid group, an acid anhydride group, an amino group, a hydroxyl group and a glycidyl group.

[0039]

As examples of modifier compounds having a carbon-carbon double bond and a carboxylic acid group and/or an acid anhydride group, there can be mentioned unsaturated dicarboxylic acids, such as maleic acid, fumaric acid, chloromaleic acid, cis-4-cyclohexene-1,2-dicarboxylic acid and acid anhydrides thereof. Among the above-mentioned compounds, fumaric acid, maleic acid and maleic anhydride are preferred, and fumaric acid and maleic anhydride are more preferred.

Further, it is also possible to use a compound which is obtained by esterifying one or two carboxyl groups of any of the above-mentioned unsaturated dicarboxylic acids.

[0040]

As examples of modifier compounds having a carbon-carbon double bond and a glycidyl group, there can be mentioned allylglycidyl ether, glycidyl acrylate, glycidyl methacrylate and epoxidized natural oils and fats.

Among the above-mentioned compounds, glycidyl acrylate and glycidyl methacrylate are especially preferred.

[0041]

As examples of modifier compounds having a carbon-carbon double bond and a hydroxyl group, there can be mentioned unsaturated alcohols represented by the following formula:

$C_nH_{2n-3}OH$  (wherein  $n$  is a positive integer), such as an allyl alcohol, 4-pentene-1-ol and 1,4-pentadiene-3-ol; and unsaturated alcohols represented by the following formulae:  $C_nH_{2n-5}OH$  and  $C_nH_{2n-7}OH$  (wherein  $n$  is a positive integer).

[0042]

The above-mentioned modifier compounds may be used individually or in combination.

The amount of the modifier compound used for producing the modified polyphenylene ether is preferably 0.1 to 10

parts by weight, more preferably 0.3 to 5 parts by weight, relative to 100 parts by weight of the polyphenylene ether.

[0043]

When a modified polyphenylene ether is produced by using a radical initiator, the radical initiator is preferably used in amount of 0.001 to 1 parts by weight, relative to 100 parts by weight of the polyphenylene ether.

It is preferred that the amount of modifier compound incorporated into the modified polyphenylene ether is 0.01 to 5 % by weight, more preferably 0.1 to 3% by weight, based on the weight of the modified polyphenylene ether.

[0044]

The modified polyphenylene ether may contain unreacted modifier compound and/or a polymer of the modifier compound.

For reducing the amount of the unreacted modifier compound and/or the polymer of the modifier compound contained in the modified polyphenylene ether, if desired, a compound having an amide linkage and/or an amino group may be added during the production of the modified polyphenylene ether.

[0045]

In the present invention, the "compound having an amide linkage" means a compound having a structure represented by the formula:  $\text{-NH-C(=O)-}$ , and the "compound having an amino

group" means a compound having a terminal -NH<sub>2</sub> group(s). Specific example of compounds having an amide linkage and/or an amino group include aliphatic amines, such as octyl amine, nonyl amine, tetramethylene diamine and hexamethylene diamine; aromatic amines, such as aniline, m-phenylenediamine, p-phenylenediamine, m-xylylenediamine and p-xylylenediamine; products obtained by reacting any of the above-mentioned amines with a carboxylic acid or a dicarboxylic acid; lactams, such as ε-caprolactam; and polyamide resins, but the compounds having an amide linkage and/or an amino group are not limited to the compounds exemplified above.

[0046]

When the compound having an amide bond and/or an amino group is used, it is preferred that the amount of the compound is 0.001 part by weight or more and less than 5 parts by weight, more preferably 0.01 part by weight or more and less than 1 part by weight, still more preferably 0.01 part by weight or more and less than 0.1 part by weight, relative to 100 parts by weight of the polyphenylene ether.

[0047]

Next, an explanation is made on the conductive filler used in the present invention.

As a conductive filler which can be preferably used in

the present invention, there can be mentioned an organic or inorganic filler which is capable of imparting conductivity to a non-conductive material and is in the form of granules, plates, flakes or fibers.

[0048]

Specific examples of conductive fillers include a conductive carbon black; a carbon fibril, such as a carbon nanotube; a carbon nanofiber; a carbon fiber; and graphite.

Among them, a conductive carbon black, a carbon nanotube and a carbon nanofiber can be preferably used, and a conductive carbon black is more preferably used.

[0049]

In the present invention, it is preferred that the conductive carbon black has a dibutyl phthalate (DBP) oil absorption of at least 250 ml, more advantageously at least 300 ml, most advantageously at least 350 ml, per 100 g of the carbon black.

[0050]

In the present invention, the DBP oil absorption is a value obtained in accordance with ASTM D2414. Further, it is preferred that the conductive carbon black used in the present invention is a carbon black having a BET surface area of at least 200 cm<sup>2</sup>, more advantageously at least 400 cm<sup>2</sup>, per

gram of the carbon black. Examples of such conductive carbon blacks which are commercially available include Ketjen black EC and a Ketjen black EC-600JD, both manufactured by Ketjen Black International Co.

[0051]

The carbon nanotube which can be used in the present invention is a hollow carbon fiber which has a fiber diameter of less than 75 nm and has only a small amount of branched structures. Such a carbon nanofiber is described in, for example, U.S. Patent Nos. 4,663,230, 5,165,909, 5,171,560, 5,578,543, 5,589,152, 5,650,370 and 6,235,674. The above-mentioned carbon nanotube may be in the form of a coil in which a pitch of the coil is 1  $\mu$ m or less. Examples of carbon nanotubes which are commercially available include hyperion (trade name; manufactured and sold by Hyperion Catalyst Co., Ltd.).

[0052]

The carbon nanofiber which can be used in the present invention is a hollow carbon fiber which has a fiber diameter of 75 nm or more and has a large amount of branched structures. Examples of carbon nanofibers which are commercially available include VGCF and VGNF (trade names; manufactured and sold by Showa Denko K.K.).

[0053]

In the present invention, the "carbon fiber" encompasses all types of fibers which are obtained by calcining and carbonizing fibers made of polyacrylonitrile (PAN) or pitch in atmosphere of inert gas at a temperature of from 1,000 to 3,500 °C. The diameter of the carbon fiber is preferably from 3 to 30  $\mu\text{m}$ , more preferably from 5 to 20  $\mu\text{m}$ .

[0054]

In the present invention, the "graphite" encompasses not only those which are obtained by heating anthracite or pitch at a high temperature in an arc furnace, but also natural graphite. The weight average diameter of graphite is preferably in the range of from 0.1 to 50  $\mu\text{m}$ , more preferably in the range of from 1 to 40  $\mu\text{m}$ , most preferably in the range of from 2 to 30  $\mu\text{m}$ .

[0055]

The amount of the conductive filler is preferably in the range of from 0.2 to 5 parts by weight, relative to 100 parts by weight of the total of the components of the conductive resin composition excluding the conductive filler, more preferably in the range of from 0.2 to 3 parts by weight. When the amount of the conductive filler is less than 0.2 parts by weight, conductivity of the resin composition becomes lowered.

On the other hand, when the amount of the conductive filler is more than 5 parts by weight, fluidity of the resin composition is impaired.

[0056]

As an example of the method for incorporating a conductive filler into the resin composition of the present invention, there can be mentioned a method in which the conductive filler is added in the form of a masterbatch obtained by melt-kneading the conductive filler with a polyamide.

The content of the conductive filler in the masterbatch is generally from 5 to 40 % by weight, preferably from 8 to 25 % by weight, based on the weight of the masterbatch.

[0057]

In the present invention, it is important that a part of the conductive filler in the masterbatch is present in the form of at least one agglomerated particle. When a part of the conductive filler in the masterbatch is present in the form of agglomerated particle(s), the conductivity of the masterbatch is improved as compared to that of a masterbatch in which the conductive filler is not present in the form of agglomerated particle(s). In the present invention, an agglomerated particle of the conductive filler has a major axis of preferably 20  $\mu\text{m}$  or more, more preferably 30  $\mu\text{m}$  or more.



The number of the agglomerated particle(s) having a major axis of 30  $\mu\text{m}$  or more is preferably 1 to 50, as observed under an optical microscope with respect to a contiguous area of 3  $\text{mm}^2$ .

[0058]

As a preferred method for producing the masterbatch, there can be mentioned a method in which the raw materials for the masterbatch are melt-kneaded by using a twin-screw extruder or a kneader. Especially preferred is a method in which a polyamide is melted, followed by addition of a conductive filler. As a specific example of such a method, there can be mentioned a method which uses a twin-screw extruder or kneader having at least one first inlet and at least one second inlet which are, respectively, provided at an upstream portion and a downstream portion of the extruder or kneader. Specifically, in this method, a polyamide is fed from the first inlet of the extruder or kneader to thereby melt the polyamide, and a conductive filler is added to the molten polyamide in the extruder or kneader from the second inlet thereof, followed by melt-kneading of the resultant mixture.

[0059]

The conductive resin composition of the present inven-

tion may contain a styrene-containing thermoplastic resin in an amount of less than 50 parts by weight, relative to 100 parts by weight of the total of the polyamide and the polyphenylene ether.

As examples of styrene-containing thermoplastic resins used in the present invention, there can be mentioned a polystyrene (homopolymer), a rubber-modified polystyrene (HIPS), a styrene-acrylonitrile copolymer (AS resin) and a styrene-rubber polymer-acrylonitrile copolymer (ABS resin).

[0060]

Any of conventional additives which can be used for a polyphenylene ether can be added to the conductive resin composition in an amount of less than 10 parts by weight, relative to 100 parts by weight of the polyphenylene ether.

[0061]

Further, the conductive resin composition of the present invention may contain an impact modifier.

As the impact modifier added to the conductive resin composition of the present invention, for example, it is possible to use at least one polymer selected from the group consisting of an aromatic vinyl compound/conjugated diene block copolymer comprising a polymer block composed mainly of aromatic vinyl monomer units and a polymer block composed

mainly of conjugated diene monomer units and a hydrogenation product thereof, and an ethylene/ $\alpha$ -olefin copolymer.

[0062]

Specific examples of aromatic vinyl compounds used for producing the aromatic vinyl compound/conjugated diene block copolymer used in the present invention include styrene,  $\alpha$ -methyl styrene and vinyl toluene. These compounds can be used individually or in combination. Among the above-exemplified compounds, styrene is especially preferred.

[0063]

Specific examples of conjugated dienes used for producing the aromatic vinyl compound/conjugated diene block copolymer used in the present invention include butadiene, isoprene, piperylene and 1,3-pentadiene. These compounds can be used individually or in combination. Among the above-exemplified compounds, preferred are butadiene, isoprene and a mixture thereof.

[0064]

With respect to the microstructure of a soft segment (composed of the conjugated diene monomer units) of the above-mentioned block copolymer, it is preferred that the 1,2-vinyl bond content or the total content of the 1,2-vinyl bond and the 3,4-vinyl bond is 5 to 80 %, more preferably 10

to 50 %, most preferably 10 to 40 %.

[0065]

It is preferred that the block copolymer used in the present invention has a block configuration selected from the group consisting of A-B, A-B-A and A-B-A-B, wherein A represents an aromatic vinyl polymer block and B represents a conjugated diene polymer block. The block copolymer used in the present invention can be a mixture of block copolymers having different block configurations.

Among the above-mentioned block configurations, A-B-A and A-B-A-B are preferred. The block copolymer can be a mixture of different block copolymers having the above-mentioned block configurations.

[0066]

Further, it is preferred that the aromatic vinyl compound/conjugated diene block copolymer used in the present invention is a hydrogenated block copolymer. The "hydrogenated block copolymer" herein means a copolymer which is obtained by hydrogenating any of the above-mentioned aromatic vinyl compound/conjugated diene block copolymers wherein the degree of hydrogenation of the aliphatic double bonds in the conjugated diene polymer block is more than 0 % and up to 100 %. The degree of hydrogenation of the hydrogenated block

copolymer is preferably 50 % or more, more preferably 80 % or more, most preferably 98 % or more.

[0067]

In the present invention, a mixture of an unhydrogenated block copolymer and a hydrogenated block copolymer can be used without causing any problem.

[0068]

With respect to the block copolymer used in the conductive resin composition of the present invention, it is preferred that the block copolymer is a mixture of a low molecular weight block copolymer and a high molecular weight block copolymer. Specifically, it is preferred to use a mixture of a low molecular weight block copolymer having a number average molecular weight of less than 120,000 and a high molecular weight block copolymer having a number average molecular weight of 120,000 or more. It is more preferred to use a mixture of a low molecular weight block copolymer having a number average molecular weight of less than 100,000 and a high molecular weight block copolymer having a number average molecular weight of 200,000 or more.

[0069]

In the present invention, the number average molecular weight is measured by means of a gel permeation chromatogra-

phy (GPC) apparatus (for example, GPC SYSTEM 21, manufactured and sold by Showa Denko Co., Japan), using an ultraviolet spectrometric detector (for example, UV-41, manufactured and sold by Showa Denko Co.) and a calibration curve obtained with respect to standard polystyrene samples. The conditions employed for measuring the number average molecular weight are as follows.

[0070]

(Conditions)

Solvent: chloroform,

Temperature: 40 °C,

Columns: columns for the sample (K-G, K-800RL and K-800R)  
and columns for the reference (K-805L, 2 columns),

Flow rate: 10 ml/min,

Wavelength used for detection: 254 nm, and

Pressure: 15 to 17 kg/cm<sup>2</sup>.

[0071]

In the measurement of the number average molecular weight, a low molecular weight component by-produced due to the deactivation of a polymerization catalyst may be detected, but such a low molecular weight component is ignored in the calculation of the molecular weight. In general, a correctly

calculated molecular weight distribution (weight average molecular weight/number average molecular weight ratio) is in the range of from 1.0 to 1.1.

[0072]

The weight ratio of the low molecular weight block copolymer to the high molecular weight block copolymer (low molecular weight block copolymer/high molecular weight block copolymer weight ratio) in the mixture of the low molecular weight block copolymer and the high molecular weight block copolymer is generally in the range of from 95/5 to 5/95, preferably 90/10 to 10/90.

[0073]

Further, in the present invention, when the low molecular weight block copolymer used in the above-mentioned mixture comprises an aromatic vinyl polymer block having a number average molecular weight of 20,000 or more, it becomes possible to improve the heat resistance of the conductive resin composition in addition to the impact resistance.

[0074]

The number average molecular weight of an aromatic vinyl polymer block of a block copolymer can be calculated from the number average molecular weight of the block copolymer mentioned above in accordance with the following formula:

$$Mn_{(a)} = \{Mn \times a / (a + b)\} / N$$

wherein  $Mn_{(a)}$  represents the number average molecular weight of the aromatic vinyl polymer block;  $Mn$  represents the number average molecular weight of the block copolymer; "a" represents the % by weight of the total of the aromatic vinyl polymer blocks, based on the weight of the block copolymer; "b" represents the % by weight of the total of the conjugated diene polymer blocks, based on the weight of the block copolymer; and N represents the number of the aromatic vinyl polymer blocks in the block copolymer.

[0075]

In the present invention, it is preferred that the aromatic vinyl polymer block content of the low molecular weight block copolymer is 55 % by weight or more and less than 90 % by weight. When the aromatic vinyl polymer block content of the low molecular weight block copolymer is within the above-mentioned range, the heat resistance of the conductive resin composition can be improved, so that the resin composition becomes more useful.

[0076]

Further, in the present invention, when the low molecu-



lar weight block copolymer is a mixture of a block copolymer having an aromatic vinyl polymer block content of 55 % by weight or more and less than 90 % by weight and a block copolymer having an aromatic vinyl polymer block content of 20 % by weight or more and less than 55 % by weight, it becomes possible to improve the melt-fluidity of the conductive resin composition.

[0077]

Before the block copolymer is mixed with the conductive resin composition of the present invention, the block copolymer may be mixed with an oil composed mainly of a paraffin. The addition of an oil composed mainly of paraffin to the block copolymer leads to the improvement in the processability of the resin composition. The amount of the oil contained in the block copolymer is preferably 1 to 70 parts by weight, relative to 100 parts by weight of the block copolymer. When the block copolymer contains more than 70 parts by weight of the oil, the handling properties of the block copolymer become poor.

[0078]

In the present invention, the oil composed mainly of a paraffin means a mixture of hydrocarbon compounds each independently having a weight average molecular weight of from

500 to 10,000, which mixture comprises an aromatic ring-containing compound, a naphthenic ring-containing compound and a paraffin compound, wherein the content of the paraffin compound is 50 % by weight or more. It is preferred that the oil contains 50 to 90 % by weight of a paraffin compound, 10 to 40 % by weight of a naphthenic ring-containing compound and not more than 5 % by weight of an aromatic ring-containing compound, based on the weight of the oil.

Such an oil composed mainly of a paraffin is commercially available. For example, there can be mentioned PW 380 which is manufactured and sold by Idemitsu Kosan Co., Ltd.

[0079]

The above-mentioned aromatic vinyl compound/conjugated diene block copolymer may be a mixture of different block copolymers so long as each of the block copolymers does not adversely affect the properties of the resin composition of the present invention. For example, the block copolymer may be a mixture of block copolymers having different block configurations, a mixture of block copolymers containing different aromatic vinyl monomer units, a mixture of block copolymers containing different conjugated diene monomer units, a mixture of block copolymers having different 1,2-vinyl contents or different total contents of 1,2-vinyl bond and 3,4-vinyl

bond, a mixture of block copolymers having different aromatic vinyl monomer unit contents, and a mixture of block copolymers having different degrees of hydrogenation.

[0080]

As a specific example of ethylene- $\alpha$ -olefin copolymers which can be used in the present invention, there can be mentioned one which is described in Unexamined Japanese Patent Application Laid-Open Specification No. 2001-302911.

[0081]

Further, the impact modifier used in the conductive resin composition of the present invention may be a modified impact modifier or a mixture of a modified impact modifier and an unmodified impact modifier.

The modified impact modifier mentioned herein means an impact modifier which is modified with at least one modifier compound having at least one unsaturated bond selected from the group consisting of a carbon-carbon double bond and a carbon-carbon triple bond and having at least one group selected from the group consisting of a carboxylic acid group, an acid anhydride group, an amino group, a hydroxyl group and a glycidyl group.

[0082]

As examples of methods for producing the modified impact

modifier, there can be mentioned (1) a method in which an impact modifier and a modifier compound are melt-kneaded in either the presence or absence of a radical initiator at a reaction temperature which is not lower than the softening temperature of the impact modifier and not higher than 250 °C, to thereby perform a reaction; (2) a method in which an impact modifier and a modifier compound are reacted with each other in a solvent therefor in either the presence or absence of a radical initiator at a temperature which is not higher than the softening temperature of the impact modifier; and (3) a method in which an impact modifier is reacted with a modifier compound in either the presence or absence of a radical initiator at a reaction temperature which is not higher than the softening temperature of the impact modifier, without causing the melting of the impact modifier. Any one of the above-mentioned methods (1) to (3) can be employed, but method (1) is preferred, and method (1) performed in the presence of a radical initiator is more preferred.

[0083]

As the above-mentioned modifier compound having at least one unsaturated bond selected from the group consisting of a carbon-carbon double bond and a carbon-carbon triple bond and having at least one group selected from the group consisting

of a carboxylic acid group, an acid anhydride group, an amino group, a hydroxyl group and a glycidyl group, any of those which are exemplified above as the modifier compound used for modifying a polyphenylene ether can be used.

[0084]

It is preferred that the conductive resin composition of the present invention contains 30 to 70 parts by weight of a polyamide, 20 to 50 parts by weight of a polyphenylene ether and 5 to 30 parts by weight of an impact modifier, relative to 100 parts by weight of the total of the polyamide, polyphenylene ether and impact modifier. It is more preferred that the conductive resin composition of the present invention contains 40 to 60 parts by weight of the polyamide, 30 to 40 parts by weight of the polyphenylene ether and 5 to 15 parts by weight of the impact modifier, relative to 100 parts by weight of the total of the polyamide, polyphenylene ether and impact modifier.

[0085]

Further, in the present invention, a compatibility agent can be incorporated into the conductive resin composition during the production thereof. In general, a compatibility agent is used mainly for the purpose of improving the physical properties of a polyamide-polyphenylene ether alloy. The

compatibility agent which can be used in the present invention is a multifunctional compound which interacts with one or both of the polyphenylene ether and the polyamide.

In the conductive resin composition of the present invention, it is preferred that the compatibility of the polyamide with the polyphenylene ether is improved, if necessary, by using the compatibility agent.

[0086]

Examples of compatibility agents which can be used in the conductive resin composition of the present invention include those which are described in Unexamined Japanese Patent Laid-Open Specification Nos. Hei 8-48869 and Hei 9-124926. All of the conventional compatibility agents described in these patent documents can be used in the present invention, and the compatibility agents can be used individually or in combination.

Among various conventional compatibility agents, especially preferred are maleic acid, maleic anhydride and citric acid.

The amount of the compatibility agent used in the conductive resin composition of the present invention is preferably 0.1 to 20 parts by weight, more preferably 0.1 to 10 parts by weight, relative to 100 parts by weight of the total

of the polyamide and the polyphenylene ether which are contained in the resin composition of the present invention.

[0087]

In the present invention, in addition to the above-mentioned components of the conductive resin composition, if desired, an additional component(s) may be added to the conductive resin composition so long as the additional component(s) does not adversely affect the excellent properties of the resin composition of the present invention.

[0088]

The additional components used in the present invention are explained below.

Examples of additional components include thermoplastic resins, such as a polyester and a polyolefin; inorganic fillers (such as talc, kaolin, xonotlite, wollastonite, titanium oxide, potassium titanate and a glass fiber); conventional adhesion modifiers which enhance the affinity between an inorganic filler and a resin; flame retardants (such as a halogenated resin, a silicone flame retardant, magnesium hydroxide, aluminum hydroxide, an organic phosphoric ester compound, ammonium polyphosphate and red phosphorus), fluororesins having an effect to prevent the dripping of flaming particles; plasticizers (such as an oil, a low mo-

lecular weight polyolefin, a polyethylene glycol and a fatty ester); auxiliary flame retardants, such as antimony trioxide; a colorant, such as a carbon black; antistatic agents; various peroxides; zinc oxide; zinc sulfide; antioxidants; ultraviolet absorbers; and light stabilizers.

[0089]

In the present invention, the amount of the additional component(s) added to the resin composition is not more than 100 parts by weight, relative to 100 parts by weight of the total weight of the polyamide, the polyphenylene ether and the impact modifier.

[0090]

As specific examples of processing apparatuses which can be used to prepare the conductive resin composition of the present invention, there can be mentioned a single-screw extruder, a twin-screw extruder, a roll, a kneader, a Brabender Plastograph and a Banbury mixer. Among these apparatuses, preferred is a twin-screw extruder, and especially preferred is a twin-screw extruder provided with a first inlet and at least one second inlet which are, respectively, formed at an upstream portion and a downstream portion of the extruder.

With respect to the melt-kneading temperature used for producing the resin composition, there is no particular limi-



tation. In general, an appropriate temperature for obtaining a desired resin composition is selected from the range of from 240 to 360 °C.

[0091]

As preferred examples of the method for producing the conductive resin composition of the present invention, there can be mentioned a method which uses a twin-screw extruder having a first inlet and a second inlet which are formed, respectively, at an upstream portion and downstream portion of the extruder, wherein an impact modifier and a polyphenylene ether are fed to the extruder from the first inlet, thereby melt-kneading together the impact modifier and the polyphenylene ether at the upstream portion of the extruder, while feeding a polyamide and a conductive filler to the extruder from the second inlet, thereby melt-kneading together the impact modifier, the polyphenylene ether, the polyamide and the conductive filler at the downstream portion of the extruder. However, this method should not be construed as limiting the scope of the present invention.

[0092]

The thus obtained conductive resin composition can be molded into various molded articles by various conventional methods, such as injection molding.

Examples of various molded articles include parts for electrical or electronic appliances, such as an IC tray, a chassis and cabinet of various disc players; parts for office automation machines, such as various computers and peripheral equipment therefor; and mechanical parts; a cowl for a motorcycle; exterior parts for automobiles, such as a fender, a door panel, a front panel, a rear panel, a locker panel, a rear bumper panel, a back door garnish, an emblem garnish, a panel for a feeding port of a fuel, an over fender, an outer door handle, a door mirror housing, a bonnet air intake, a bumper, a bumper guard, a roof rail, a roof rail leg, a pillar, a pillar cover, a wheel cover, various aero parts (such as a spoiler), various moles and emblems for an automobile; and interior parts for automobiles, such as an instrument panel, a console box and a trim.

Among the above-exemplified molded articles, the conductive resin composition of the present invention is suitable for producing an exterior part of an automobile which can be electrostatically coated.

[0093]

[Examples]

Hereinbelow, the present invention will be described in more detail with reference to the following Examples and Com-

parative Examples, which should not be construed as limiting the scope of the present invention.

[0094]

(Raw Materials)

In the following Examples and Comparative Examples, the following raw materials were used.

(1) Polyamide 6 (hereinafter, abbreviated to "PA")

Trade name: UBE Nylon 6 SF1013A (manufactured and sold by UBE INDUSTRIES, LTD.)

(2) Conductive filler

Conductive carbon black (hereinafter, abbreviated to "KB")

Trade name: Ketjenblack EC-600JD (manufactured and sold by Ketjenblack International Corporation)

(3) Polyphenylene ether (hereinafter, abbreviated to "PPE")

Poly(2,6-dimethyl-1,4-phenylene ether)

Reduced viscosity: 0.42 dl/g (measured at 30 °C using a 0.5 g/dl chloroform solution of PPE)

(4) Polystyrene (hereinafter, abbreviated to "PS")

Trade name: A & M Polystyrene 685 (manufactured and sold by A & M Styrene Co., Ltd.)

(5) Citric acid

Citric acid (manufactured and sold by Wako Pure Chemical Industries, Ltd.)

[0095]

(Measuring methods)

The methods for measuring the number of agglomerated particles of conductive filler (hereinafter, referred to as "number of agglomerated particles") and conductivity (surface resistivity and volume resistivity) are explained below.

<Number of agglomerated particles>

A pellet of a resin composition was cut by means of a microtome equipped with a glass knife to thereby obtain a cross-section. The cross-section was observed with a magnification of  $\times 50$  under an optical microscope ("PME3", manufactured and sold by Olympus Optical Co. Ltd.), and a photomicrograph of the cross-section was taken. With respect to a contiguous area of  $3 \text{ mm}^2$  in the photomicrograph, the number of agglomerated particles each independently having a major axis of  $30 \text{ }\mu\text{m}$  or more was counted by visual observation.

[0096]

<Surface resistivity and volume resistivity>

Pellets of a resin composition were molded into a test plate (size:  $100 \times 50 \times 2.5 \text{ mm}$ ) by using a molding machine IS-80EPN (under conditions wherein the cylinder temperature

was 280 °C and the mold temperature was 80 °C). The surface resistivity and the volume resistivity of the obtained test plate were measured by using a high resistivity meter (MCP-HT450, manufactured and sold by MITSUBISHI CHEMICAL CORPORATION) at 500 V. The measurement was performed with respect to five different test plates (each prepared in the above-mentioned manner) and each of the surface resistivity value and the volume resistivity value was obtained in terms of the average value of the five measured values.

[0097]

[Comparative Example 1]

In accordance with the method described in the single Example of Patent document 2, conductive carbon black was uniformly dispersed in a polyamide to thereby produce a masterbatch. With respect to the obtained masterbatch (hereinafter, abbreviated to "PA/KB-MB1"), the number of agglomerated particles contained therein were measured. Further, by using the obtained masterbatch, pellets of a resin composition comprising a polyamide, a polyphenylene ether and conductive carbon black were produced in accordance with the method described in the single Example of Patent document 2 and the surface resistivity and volume resistivity of the resin composition were measured. The properties of the resin

composition are shown in Table 1, together with the formulation of the resin composition.

[Example 1]

A masterbatch was produced in substantially the same manner as in Comparative Example 1, except that the design of the screws of the twin-screw extruder was changed so that the melt-kneading conditions employed in Example 1 were mild as compared to those employed in Comparative Example 1. With respect to the obtained master batch (hereinafter, abbreviated to "PA/KB-MB2"), the number of agglomerated particles contained therein was measured. Further, by using the obtained masterbatch, pellets of a resin composition comprising a polyamide, a polyphenylene ether and conductive carbon black were produced. With respect to the obtained pellets, the surface resistivity and volume resistivity of the resin composition were measured. The properties of the resin composition are shown in Table 1, together with the formulation of the resin composition.

[0098]

[Table 1]

	unit	Comparative Example 1	Example 1
Components of resin		Resin composition	
PPE	Parts by weight	38	38
Citric acid		1	1
PS		12	12
PA		6.5	6.5
PA/KB-MB1		37.5	-
PA/KB-MB2		-	37.5
Results of measurement			
Number of agglomerated particles	pieces	0	9
Surface resistivity	Ω	4.5×10 <sup>9</sup>	3.6×10 <sup>7</sup>
Volume resistivity	Ω · cm	3.7×10 <sup>10</sup>	3.0×10 <sup>7</sup>

[0099]

From Table 1, it is apparent that the conductivity of a resin composition comprising a polyamide, a polyphenylene ether and conductive carbon black can be remarkably improved by the use of the masterbatch in which the conductive filler is present in the form of at least one agglomerated particle.

[0100]

[Effect of the Invention]

By the use of the masterbatch in which the conductive filler is present in the form of at least one agglomerated particle, the conductive resin composition of the present invention exhibits an excellent conductivity and, hence, can be

used as a molding material for use in producing a molding material suitable for electrostatic coating.



[Name of Document] Abstract

[Abstract]

[Task] It is a task of the present invention to provide a masterbatch for producing a resin composition having a conductivity which is sufficient for the resin composition to be electrostatically coated, and to provide a resin composition and a molded article which are produced using the masterbatch.

[Means to Solve the Task] For imparting a conductivity to a resin composition, a conductive masterbatch comprising a polyamide and a conductive filler, in which a part of the conductive filler is present in the form of at least one agglomerated particle, is used. The conductive filler is at least one member selected from the group consisting of a conductive carbon black, a carbon nanotube, a carbon nanofiber, a carbon fiber and graphite. It is preferred that a part of the conductive filler is present in the form of at least one agglomerated particle having a major axis of 20  $\mu\text{m}$  or more.

[Selected Figure] None

2001-377006

Recognition · Additional Information

Application Number	Patent Application No. 2002-377006
Receipt Number	50201974823
Name of Document	Patent Application
Official in Charge	Senior Official in charge of the 6th Section 0095
Date of Preparation	January 6, 2003

<Recognized Information · Additional Information>

[Filing date]	December 26, 2002
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2002-377006

Historical Information on Applicant

Identification Number [000000033]

1. Date of Change January 4, 2001

[Reason for Change] Change of Name

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